(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
22 March 2001 (22.03.2001)

PCT

(10) International Publication Number
WO 01/20946 A1

(51) International Patent Classification[7]: H04Q 7/38

(21) International Application Number: PCT/US00/22261

(22) International Filing Date: 11 August 2000 (11.08.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
09/396,990 15 September 1999 (15.09.1999) US

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(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:
— *With international search report.*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: METHOD AND SYSTEM FOR SPECIFYING A QUALITY OF SERVICE FOR COMMUNICATION BETWEEN A MOBILE STATION AND A PACKET WIRELESS COMMUNICATIONS NETWORK

(57) Abstract: A mobile station executes voice, data processing or multimedia applications that generate respective voice, processed data or multimedia communications that are communicated to a packet wireless communications network by the mobile station as packetized data. A quality of service is specified for the mobile station based upon the voice, data processing or multimedia application that is executing on the mobile station, independent of the performance characteristics of the packet wireless communications network. This specified quality of service is conveyed from the mobile station to the packet wireless communication network. Communications then may be established with the mobile terminal based upon the specified quality of service and the characteristics of the packet wireless communications network. The present application may be particularly advantageous for communicating between a Mobile Station (MS) and an Enhanced General Packet Radio Service (EGPRS) Radio Access Network (RAN). The MS includes Terminal Equipment (TE) that executes voice, data processing or multimedia applications that generate respective voice, processed data or multimedia communications. The MS also includes a Mobile Terminal (MT) that communicates the voice, processed data or multimedia communications to the EGPRS RAN as packetized data. The TE specifies a quality of service for the communications between the TE and the GPRS RAN based upon the voice, data processing or multimedia application that is executing on the TE. The specified quality of service is conveyed from the TE to the MT. The specified quality of service then is communicated from the MT to the EGPRS RAN. Communications then may be established with the MS based upon the specified quality of service and the characteristics of the EGPRS RAN.

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METHODS AND SYSTEMS FOR SPECIFYING A QUALITY OF SERVICE FOR COMMUNICATION BETWEEN A MOBILE STATION AND A PACKET WIRELESS COMMUNICATIONS NETWORK

FIELD OF THE INVENTION

This invention relates to radio communication systems and methods, and more particularly to systems and methods for transmitting and receiving data on a radio channel.

BACKGROUND OF THE INVENTION

Public wireless radiotelephone systems are widely used to provide radiotelephone communications to subscribers. For example, the Global System for Mobile communications (GSM) system has been in service since the early 1990's. The design and operation of the GSM system is well known to those having skill in the art and need not be described further herein.

The GSM system has been extended in order to facilitate wireless packet data communications. In particular, the General Packet Radio Service (GPRS) has been designed to facilitate packet data communications over a radio channel. The GPRS system is described, for example, in European Telecommunications Standards Institute (ETSI) publication GSM 03.60 V.5.2.0 1997-1 entitled *Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Service description; Stage 2 (GSM 03.60 version 5.2.0)*, the disclosure of which is incorporated herein by reference. The design and operation of GPRS is well known to those having skill in the art and need not be described further herein.

Extensions of GPRS, such as Enhanced GPRS (EGPRS) and Enhanced Data Rates for GSM Evolution (EDGE), now are being designed to facilitate high speed communication of multimedia data and packet-based voice, while allowing enhanced compatibility with external network protocols such as the Internet Protocol (IP). The EGPRS and EDGE systems are described in GSM 04.60 V6.2.0 (1998-10) entitled *Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Mobile Station (MS) – Base Station System (BSS) interface; Radio*

Link Control/Medium Access Control (RLC/MAC) protocol (GSM 04.60 Version 6.2.0 Release 1997) and GSM 05.03 V8.0.0 (1999-07) entitled *Digital Cellular Telecommunications System (Phase 2+); Channel Coding* (GSM 05.03 Version 8.0.0 Release 1999), the disclosures of which are hereby incorporated herein by reference. The design and operation of EGPRS and EDGE are well known to those having skill in the art and need not be described further herein.

Figure 1 is an overall block diagram of a GPRS architecture. As shown in Figure 1, the GPRS architecture includes a plurality of Mobile Stations (MS) that communicate with the GPRS network using a wireless radiotelephone link. An MS includes a Mobile Terminal (MT) and Terminal Equipment (TE). It will be understood that although the TE and MT are illustrated herein as two separate blocks, they may be implemented using shared components in a single portable housing. The Um access point is used for mobile access and the R reference point is used for origination or reception of messages. An inter-GPRS interface Gp connects two independent GPRS networks for message exchange. The Gi reference point connects the GPRS network to a Packet Data Network (PDN) or other networks. There may be more than a single GPRS network interface to several different packet data or other networks. These networks may both differ in ownership as well as in communications protocol such as X.25, TCP/IP, etc.

Figure 2 is an overview of a GPRS logical architecture. As shown in Figure 2, GPRS is logically implemented on a GSM structure through the addition of two network nodes, the serving GPRS Support Node (SPSN) and the Gateway GPRS Support Node (GGSN). The GGSN is a node that is accessed by the packet data network due to evaluation of a packet data protocol address. It contains routing information for attached GPRS users. The SGSN is the node that is serving the MS. At GPRS attach, the SGSN establishes a mobility management context containing information pertaining to, for example, mobility and security for the MS. The MS communicates with a plurality of Base Station Systems (BSS) using a wireless radiotelephone link. Other details of the GPRS logical architecture may be found in GSM 03.60 cited above, and need not be discussed further herein.

Figure 3 illustrates a transmission plane of a GPRS system. As shown in Figure 3, the transmission plane includes a layered protocol structure providing user information transfer, along with associated information transfer control procedures such as flow control, error detection, error correction, and error recovery. The

transmission plane independence of the network subsystem platform from the underlying radio interface may be preserved via the Gb interface. As shown in Figure 3, the primary Layer 2 (L2) interface between the MS and the BSS is through the Radio Link Control/Medium Access Control (RLC/MAC) block. The RLC portion offers access to control mechanisms associated with the radio resource. The MAC portion allows access to a physical layer. The transmission plane of Figure 3 and the RLC/MAC block are defined in the above-cited GSM 03.60 and GSM 04.60.

As the circuit switched GSM system evolves to a packet switched service architecture such as EGPRS and/or EDGE, it is desirable to allow the Mobile Terminal to execute voice, data processing or multimedia applications (including combinations thereof) that generate respective voice, processed data or multimedia communications. It also is desirable to effectively communicate the voice, processed data or multimedia communications to the GPRS Network and/or the other networks such as PDNs as packetized data. Unfortunately, it may be difficult to provide these voice, processed data or multimedia communications with adequate Quality of Service (QoS).

Networks based on the Universal Mobile Telephone System (UMTS) can provide a variable quality of service for a variety of service applications including voice telephony. However, this may be difficult in a network that uses Internet Protocol (IP). Networks that interface to UMTS Terrestrial Radio Access Network (UTRAN) or the EGPRS Radio Access Network (ERAN) may attempt to provide appropriate quality of service through mediation by servers that implement media gateway and media control functionality.

Unfortunately, it may be difficult to adapt a negotiated quality of service within the wireless network according to the changing conditions of the wireless link. Stated differently, it is desirable for applications and services that run in external networks to be independent of the wireless link that is used, for example, for the last-leg transport. It also may be unreasonable to expect the GPRS network and/or other networks to know all the nuances related to providing proper quality of service for the various applications being executed on the Mobile Station. Stated differently, services offered from external networks such as the Internet should not be required to have knowledge of the needs of Mobile Stations.

It is known to provide an appropriate quality of service using techniques such as implicit flow classification. In such techniques, a subscriber's user profile may be

combined with assumptions about the characteristics of the flow. For example, RTP/UDP/IP traffic occurring periodically may imply a real-time flow. Unfortunately, some parameters, such as the delay sensitivity of the application being used, may not be readily accessible using implicit techniques. It also is possible to use explicit flow classification in order to provide information about the characteristics of the wireless link.

Although the above-described techniques may factor the wireless link into quality of service considerations, they may be inadequate to provide proper quality of service for a Mobile Station that executes voice, data processing or multimedia applications. Moreover, implicit techniques may not provide an accurate determination of quality of service needs for voice, data processing or multimedia applications and may be unable to distinguish between these applications.

SUMMARY OF THE INVENTION

It therefore is an object of the present invention to provide improved systems and methods for transmitting and receiving data on radio channels.

It is another object of the present invention to allow accurate estimation of a desired quality of service for communications between a mobile station and a packet wireless communications network.

It is still another object of the present invention to allow a mobile station to execute voice, data processing or multimedia applications with acceptable quality of service.

These and other objects may be provided according to the present invention by methods and systems for communicating between a mobile station and a packet wireless communications network wherein the mobile station executes voice, data processing or multimedia applications, including combinations thereof, that generate respective voice, processed data or multimedia communications that are communicated to the packet wireless communications network by the mobile station as packetized data. According to the invention, a desired quality of service is specified for the mobile station based upon the voice, data processing or multimedia application that is executing on the mobile station, preferably independent of the performance characteristics of the packet wireless communications network. This specified quality of service is conveyed from the mobile station to the packet wireless communication network. Communications then may be established with the mobile

station based upon the specified quality of service and the characteristics of the packet wireless communications network.

The quality of service preferably comprises at least one of a delay sensitivity and an error rate. The quality of service may be specified by the voice, data processing or multimedia application that is executing on the mobile station and/or may be designated by a user of the voice, data processing or multimedia application that is executing on the mobile station.

The invention stems from the realization that, when a mobile station executes a voice, data processing or multimedia application, neither the radio access network nor the other networks generally have knowledge of the particular type of application that is being executed on the mobile station. However, since the mobile station has knowledge of the application that it is executing, it can convey a desired quality of service to the packet wireless communication network based on the application that is executing on the mobile station. This specified quality of service, that preferably is independent of the performance characteristics of the packet wireless communication network, can be used to establish communications with the mobile station.

For example, a voice telephony application may have delay requirements that are stringent, such as a one-way end-to-end delay that is on the order of 100 milliseconds. This means that the delay on the wireless link preferably should be 60 ms or less. On the other hand, a videoconference application may accept longer delays in return for good performance. Such an application may be able to accept delays on the order of 200-500 ms. This information generally is not available to the radio access network or to the core network for applications that are executing on a mobile station. However, according to the present invention, a quality of service may be specified by the mobile station for the mobile station, based upon the voice, data processing or multimedia application that is executing on the mobile station.

The present invention may be particularly advantageous for communicating between a Mobile Station (MS) and an Enhanced General Packet Radio Service (GPRS) Radio Access Network (RAN). The MS comprises Terminal Equipment (TE) that executes voice, data processing or multimedia applications that generate respective voice, processed data or multimedia communications. The MS also comprises a Mobile Terminal (MT) that communicates the voice, processed data or multimedia communications to the EGPRS RAN as packetized data. According to the invention, the TE specifies a quality of service for the communications between

the TE and the EGPRS RAN based upon the voice, data processing or multimedia application that is executing on the TE. The specified quality of service is conveyed from the TE to the MT. The specified quality of service then is communicated from the MT to the EGPRS RAN. Communications then may be established between the MS and the EGPS RAN based upon the specified quality of service and the characteristics of the EGPRS RAN.

In a preferred embodiment, a Quality of Service application runs on a User Datagram Protocol (UDP) layer of the TE and allows the voice, data processing or multimedia application that is executing on the TE to specify a quality of service. A socket-based extension to the R reference point between the TE and MT may be used to convey the specified quality of service from the TE to the MT using a Point-to-Point Protocol (PPP) link layer. A Quality of Service application may run on the UDP layer of the MT to communicate the specified quality of service from the MS to the EGPRS RAN using the Um access point. Accordingly, a socket-based Application Program Interface (API) can allow control of quality of service in a radio access network. Improved communication of voice, processed data or multimedia communications between a mobile station and a packet wireless communications network thereby may be provided.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is an overall block diagram of a GPRS system.

Figure 2 illustrates a logical architecture for a GPRS system.

Figure 3 illustrates a conventional protocol stack for the transmission plane of a GRPS system.

Figure 4 illustrates an overall architecture for an EGPRS Radio Access Network (ERAN).

Figure 5 is a block diagram of an ERAN reference architecture.

Figure 6 illustrates a user plane protocol for an EGPRS system.

Figure 7 illustrates a protocol stack for the Terminal Equipment and Mobile Terminal of a Mobile Station according to an embodiment of the present invention.

Figure 8 is a flowchart that illustrates operations for communicating between a Mobile Station and a GPRS network according to an embodiment of the present invention.

Figures 9A and 9B illustrate examples of an RLC/MAC block for GPRS/EGPRS in 8-Phase Shift Keying (8PSK) mode and Gassian Minimum Shift Keying (GMSK) mode, respectively.

Figure 10 illustrates an example of changing interleaving based on a specified quality of service according to an embodiment of the present invention.

Figures 11A and 11B illustrate Man-Machine Interfaces for Mobile Terminals that allow user specification of quality of service according to an embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

The present invention now will be described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout.

As will be appreciated by one of skill in the art, the present invention may be embodied as methods, systems (apparatus), or computer program products. Accordingly, the present invention may take the form of an entirely hardware embodiment, an entirely software embodiment or an embodiment combining software and hardware aspects.

Various aspects of the present invention are illustrated in detail in the following Figures, including block diagram and flowchart illustrations. It will be understood that each block, and combinations of blocks, can be implemented by computer program instructions. These computer program instructions may be provided to a processor or other programmable data processing apparatus to produce a machine, such that the instructions which execute on the processor or other programmable data processing apparatus create means for implementing the functions specified in the block or blocks. These computer program instructions may also be stored in a computer-readable memory that can direct a processor or other programmable data processing apparatus to function in a particular manner, such that the instructions stored in the computer-readable memory produce an article of

manufacture including instruction means which implement the functions specified in the flowchart block or blocks.

Accordingly, blocks of the illustrations support combinations of means for performing the specified functions, combinations of steps for performing the specified functions and program instructions for performing the specified functions. It will also be understood that each block of the illustrations, and combinations of blocks in the illustrations, can be implemented by special purpose hardware-based computer systems which perform the specified functions or steps, or by combinations of special purpose hardware and computer instructions.

The present invention can provide an Application Program Interface (API) that allows voice, data or multimedia applications that are executing on the Terminal Equipment to specify key parameters to the Extended Radio Access Network Application (ERANAP) layer from the Mobile Terminal using a socket-based interface carried by UDP. The parameters can include a quality of service indication from the Mobile Terminal based upon the voice, data processing or multimedia application that is executing on the Terminal Equipment. The specified quality of service can include a delay sensitivity, an error rate, a desired quality of sound to be negotiated from the channel and/or other parameters. The quality of service specification may be conveyed from the Terminal Equipment to the Mobile Terminal over a PPP link from the Terminal Equipment to the Mobile Terminal using, for example, the R reference point in an EGPRS Mobile Station. This can allow quality of service provisioning with great flexibility.

For example, the delay requirements for real-time IP service generally will vary depending upon the application or service being accessed. Voice delay requirements generally are stringent. In particular, the one-way end-to-end delay may need to be on the order of 100 ms. Thus, the delay on the wireless link preferably should be 40 ms or less. On the other hand, a video stream may have much looser delay requirements and a low rate digital videoconference session can sustain delays of 200-500 ms for a one-way link. Voice streams associated with the video conference may be subject to similar delays. Frame Error Rate (FER) requirements generally are similar for video streams and voice, *i.e.*, about 1% FER.

Delay for collaborative applications such as whiteboarding or talk sessions generally are similar to those for video streams at about 300-500 ms. Unidirectional streams for media content on the world-wide web generally do not have specific delay

requirements, other than those imposed by the limited memory in the rendering buffers at the destination. However, frame error requirements still are expected to be about 1%. Future applications may be implemented with similar or less stringent frame error rates. However, there may be a need for lower frame error rates for specific applications.

The present invention stems from the realization that the GPRS network and other networks generally do not have knowledge of the application that runs on the Terminal Equipment. However, the Mobile Terminal is associated closely with the applications running on the Terminal Equipment. Accordingly, the present invention allows the Mobile Terminal to specify a quality of service for the Mobile Station based upon the voice, data processing or multimedia application that is executing on the Terminal Equipment, preferably independent of the performance characteristics of the packet wireless communication network. Quality of service may be specified directly by specifying a delay sensitivity and/or error rate. Alternatively, quality of service may be specified by conveying to the radio access network, the type of application that is executing on the terminal equipment, such as a multimedia application, a videoconference or a voice telephony application. Other conventional techniques for specifying a quality of service also may be used.

A preferred technique for specifying quality of service allows an application executing on the Terminal Equipment to make specific requests of the radio access network. Thus, for example, the Terminal Equipment may choose an interleaving depth based on the application that it executing thereon. In one embodiment, a 4-bit code may be assigned to various interleaving options that are available on the GPRS network. Table 1 specifies one possible set of 4-bit codes that are used to specify interleaving depth choice.

TABLE 1

CODE	INTERLEAVING
0000	No interleaving
0001	Block interleaving over 20ms
0010	Block interleaving over 40ms
0011	Diagonal interleaving over 40ms
0100	Block interleaving over 60ms
...	...

1000	Reserved for future use
1111	Reserved for future use
...	...

Thus, the Terminal Equipment may select a code for a desired interleaving depth choice based on the application that is executed thereon. Similarly, the Terminal Equipment may select a particular coding scheme based on the application that is executing thereon by specifying a 4-bit code point. Table 2 illustrates one embodiment of 4-bit codes that can be used to specify coding.

TABLE 2

CODE	CODING
0000	Uncoded
0001	Conventional EGPRS release 99 incremental redundancy for best effort
0010	Real-time bearer convolutional coding in the link adaptation
0100	Turbo-code of payload spanning 40ms
0101	Turbo-code of payload spanning 100ms
1000	Reserved for future use
...	...
1111	Reserved for future use
...	...

Turbo-codes are well known to those having skill in the art and are described for example in a publication entitled *Near Shannon Limit Error – Correcting Coding and Decoding: Turbo-Codes(1)* by Berrou, et al., IEEE, International Communications Conference, 1993.

The present invention may be used in an EGPRS Radio Access Network (ERAN). Figure 4 illustrates of an overall architecture for an ERAN. As shown in Figure 4, the ERAN functional entity includes three functional subentities: the Radio Network Control Functionality (RNCF), the Radio Network Gateway (RNGW), and the Base Station Transceiver (BTS). The Base Station Transceiver may be functionally equivalent to that defined in GSM 03.60. The ERAN can support real-

time IP-based applications. The IuPs' interface includes two planes: the user plane, denoted as IuPS '-u, and the control plane, denoted as IuPS'-c. The user plane interface is between the Enhanced Serving GPRS Support Node (E-SGSN) and the RNGW. The control plane interfaces between the E-SGSN and the RNCF.

Figure 5 is a block diagram of an ERAN reference architecture. The ERAN reference architecture can provide complete separation of Core Network and Radio Access Network functionality into distinct components. The ERAN reference architecture also can provide one common packet switched code network based on GPRS for all access networks, for example, for both the ERAN and the UMT Terrestrial Radio Access Network (UTRAN).

Figure 6 illustrates a user plane protocol for an EGPRS system. The R99 and R2000 RLC/MAC layers may differ in the MAC layer procedures alone. The Sub-Network Dependent Convergence Protocol (SNDCP) and Logical Link Control (LLC) layers may be treated as sublayers of the Release 99 Link Layer. The Radio Resource Management Entity is common to each of the user plane stacks shown. Thus, radio resources may be drawn from a common pool. All link layers shown may be managed using a common Link Layer Management Entity (LLME), whose interface to higher layer protocols may be a dynamically assigned Network layer Service Access Point Identifier (NSAPI), and whose interface to lower layers is a link layer SAPI along with Temporary Logical Link Identity (TLLI).

The Best Efforts-Logical Link Control (BE-LLC) layer reduces link layer overhead for best-effort traffic, and provides unacknowledged transfer of IP datagrams with optional protocol and data compression. The BE-LLC layer preferably is transparent (after header compression) in the user plane for flows that are restricted to single time-slot operation. Minimal overhead may be added to allow multi-slot operation. The Real Time-Logical Link Control (RT-LLC) layer allows transfer of IP/UDP or IP/UDP/RTP data with protocol compression. This layer can carry real time flows with end-to-end IP connectivity. An optional single slot with transparency in the user plane after header compression also may be provided.

The Optimized Voice Transport over EGPRS/Optimized Voice Transfer over GSM circuit bearers (OVE/OVG) options allow optimized transfer of Adaptive Multi-Rate (AMR) voice using either EGPRS or GSM circuit bearers. These bearers can provide a single time slot Temporary Flow Identifier (TFI) for transport of low rate speech.

Figure 7 illustrates a protocol stack for the Terminal Equipment and Mobile Terminal of a Mobile Station according to the present invention. As shown, voice, data or multimedia applications **510**, **520**, and **530** respectively, execute in an application layer on the UDP layer **540** of the Terminal Equipment. The voice, data or multimedia applications **510**, **520**, and **530** respectively, interface to a quality of service application **550** that also preferably executes in the application layer on the UDP layer **540**. The quality of service application **550** interfaces with an Object Resource Broker (ORB) **560** that runs in an application layer on the UDP layer **570** of the Mobile Terminal. The Object Resource Broker interfaces with an EGPRS Radio Access Network Application Part (ERANAP) **580**. Thus applications **510**, **520**, and **530** can negotiate specific requirements using the ORB **560**. Using a socket-based interface, the application informs the ERANAP running on the MT about the FER and/or delay requirements for the flow. The ERANAP can translate the requirements into specific requests and can initiate renegotiation procedures for the associated communication channel.

For example, if the application has 20 ms transmission granularity and can sustain delays of up to 100 ms in the radio network without significant perceived quality loss, a request for interleaving the data portion diagonally over 4-5 Protocol Data Units (PDU) may be sent to the ERAN. The Radio Network Control Functionality (RNCF) can alter the characteristics for an interleaving delay for 100 ms. A trade-off for other users may be that there is a delay before releasing a channel during this continuous transmission.

Alternatively, or in addition, the ORB **560** can be used to negotiate performance requirements. For example, there may be a need for a packet error rate of 0.1%. The application **510-530** could then negotiate channel coding and interleaving with the ORB **560** through the quality of service application **550** to provide the desired performance.

Different pricing may be associated with different quality of service, and appropriate billing may be triggered by the quality of service that is provided. Accordingly, the negotiation of specialized radio access bearers providing customized quality of service can trigger the modification of charging procedures for the flow, that account for the use of radio resources. One technique for implementing this charge is to compute the cost of transmitting a packet as $C_p=B_c \cdot \mu_r + \nu_r$, where B_c is

base cost of transmission, μ_r is a multiplier that is unique to the quality of service being used for the flow, and ν_r is a fixed cost per packet for the use of radio resources.

Figure 8 is a flowchart that illustrates operations for communicating between a Mobile Station and a GPRS network according to the present invention. As shown at block **610**, the Terminal Equipment initializes a voice, data or multimedia application **510-530**. At block **620**, the application specifies a quality of service to the quality of service application **550**. Alternatively, or in addition, the quality of service application **550** may accept a specified quality of service from the user of the Terminal Equipment at block **630**. User specification of quality of service will be described in detail below.

Continuing with the description of Figure 8, at block **640**, the quality of service application **550** conveys a specified quality of service to the Mobile Terminal, for example using a socket-based R interface and the Object Resource Broker **560**. At block **650**, the Mobile Terminal communicates a specified quality of service to the GPRS RAN using the ERANAP **580**. The GRPS RAN then establishes communications with the voice, data or multimedia application based upon the quality of service and the performance characteristics of the GPRS RAN at block **660**.

Figures 9A and 9B illustrate examples of embodiments of RLC/MAC blocks for GPRS/EGPRS systems in an 8 Phase Shift Keying (8PSK) and Gaussian Minimum Shift Keying (GMSK) mode, respectively. After channel coding, the RLC/MAC block spans 4 time slots that are distributed (interleaved) over 4 frames, each frame including 8 slots, in the GSM Time Division Multiple Access (TDMA) frame structure. The coded data generally is interleaved over these 4 time slots. The coding rate achievable can vary between 1/12 and 1/5 for 8PSK and 1/4 to 1/2 for GMSK. The RLC/MAC block includes an Uplink State Flag (USF) field that allows the Mobile Terminals to sense the state of the uplink channel. A Payload Type (PT) flag identifies the type of real-time traffic. A Temporary Flow Identifier (TFI) field identifies the Temporary Block Flow to which the data belongs. A Power Reduction (PR) field denotes the reduction in power relative to the BCCH in the next RLC/MAC block. A Coding and Puncturing (CPS) field denotes the channel coding protocol. An encryption indicator (K) denotes whether encryption is active. CRC is a Cyclic Redundancy Check field. The fields in the RLC/MAC block are well known to those having skill in the art and need not be described in further detail herein.

Referring now to Figure 10, an example of the present invention will be described. The example assumes that a data unit of 36 octets is convolutionally coded for concatenation with an RLC/MAC header of Figure 9A or 9B. The distribution of these 36 octets in RLC/MAC blocks varies depending on the interleaving negotiated for the RAB. For example, as shown in Figure 10, two data units of 36 octets may be diagonally interleaved prior to construction of the RLC/MAC block of Figure 9A or 9B. Alternatively, interleaving may be block oriented. The characteristics of the interleaving for the communication may be stored in the RLC/MAC context for the communication after error negotiations, and need not be signaled over the radio link.

As was described above in connection with Figure 8, at block **630**, the present invention also contemplates user specification of quality of service instead of or in addition to specification by an application **510-530**. Figures 11A and 11B illustrate Man-Machine Interfaces (MMI) on a mobile station that allows user specification of quality of service. Figure 11A illustrates a mobile station **900** having a touch screen display **910** with a quality of service slider **920** displayed thereon. Figure 11B illustrates up and down buttons **930** and **940**, respectively, on the display **910** of the mobile station **900**. Other aspects of the design of the mobile station **900** are well known to those having skill in the art, and need not be described further herein.

Thus, the user can dynamically specify the desired quality of service using buttons, sliding controls or other well-known user interfaces. The primitives that the user can select may be based on generalities, such as less delay or more delay. Another control may be used to control the perceived quality of a voice or a video application by specifying better quality or lower quality. The user selection may be mapped using a Venn diagram or other approach into characteristics that are available from the network. For example, the user input may be translated into directives to change 40 ms of interleaving to 80 ms of interleaving. The data portion then may be interleaved appropriately after renegotiating procedures are carried out.

Transition from one interleaving scheme to another may be accomplished by insertion of dummy frames allowing a temporary flow suspension, and re-establishment of the Temporary Block Flow (TBF) at the RLC/MAC layer. Alternatively, the transition may be accomplished using handover procedures. Transitions from one coding scheme to another also may be accomplished using other standard link adaptation procedures. One of the uses of the quality of service provision may be to limit performance so that lower data rates may be utilized,

allowing cheaper access to radio resources. The user thus may be given control over the quality of service and the cost of service as well.

From a service-oriented viewpoint, an IP based transport network can be completely unaware of the specific application that is requesting the network resources. Stated differently, all data may be treated equally in an IP based transport network. Unfortunately, however, the specific application that is executing on Terminal Equipment, such as voice, data or multimedia, may require differing quality of service for acceptable performance. The present invention allows the Mobile Station to specify a quality of service based upon the voice, data processing or multimedia application that is executing on the Terminal Equipment, so that the Radio Access Network and/or the other networks can provide acceptable quality of service, without knowledge of the application that is executing.

In the drawings and specification, there have been disclosed typical preferred embodiments of the invention and, although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation, the scope of the invention being set forth in the following claims.

WHAT IS CLAIMED IS:

1. A communication method between a mobile station and a packet wireless communications network, the mobile station executing voice, data processing or multimedia applications that generate respective voice, processed data or multimedia communications that are communicated to the packet wireless communications network by the mobile station as packetized data, the method comprising the following steps that are performed by the mobile station:

specifying a quality of service for the mobile station based upon the voice, data processing or multimedia application that is executing on the mobile station; and

conveying the specified quality of service from the mobile station to the packet switched wireless communication network.

2. A method according to Claim 1 further comprising the following step that is performed by the packet wireless communications network:

establishing communications with the mobile station based upon the specified quality of service and the characteristics of the packet wireless communications network.

3. A method according to Claim 1 wherein the step of specifying a quality of service comprises the step of:

specifying a quality of service for the mobile station based upon the voice, data processing or multimedia application that is executing on the mobile station and that is independent of performance characteristics of the packet wireless communication network.

4. A method according to Claim 1 wherein the specified quality of service comprises at least one of a delay sensitivity and an error rate.

5. A method according to Claim 1 wherein the step of specifying comprises:

accepting a quality of service specification at the mobile station from a user of the voice, data processing or multimedia application that is executing on the mobile station.

6. A communication method for a mobile station that communicates with a packet wireless communications network, the mobile station executing voice, data processing or multimedia applications that generate respective voice, processed data or multimedia communications that are communicated to the packet wireless communications network by the mobile station as packetized data, the method comprising the steps of:

specifying a quality of service based upon the voice, data processing or multimedia application that is executing on the mobile station; and

conveying the specified quality of service to the packet switched wireless communication network.

7. A method according to Claim 6 further comprising the step of:

receiving communications from the packet wireless communications network based upon the specified quality of service and the characteristics of the packet wireless communications network.

8. A method according to Claim 6 wherein the step of specifying a quality of service comprises the step of:

specifying a quality of service based upon the voice, data processing or multimedia application that is executing on the mobile station and that is independent of performance characteristics of the packet wireless communication network.

9. A method according to Claim 6 wherein the specified quality of service comprises at least one of a delay sensitivity and an error rate.

10. A method according to Claim 10 wherein the step of specifying comprises:

accepting a quality of service specification from a user of the voice, data processing or multimedia application that is executing on the mobile station.

11. A communication method for a packet wireless communications network that communicates with a mobile station, the mobile station executing voice,

data processing or multimedia applications that generate respective voice, processed data or multimedia communications that are communicated to the packet wireless communications network by the mobile station as packetized data, the method comprising the steps of:

receiving from the mobile station an indication of a quality of service based upon the voice, data processing or multimedia application that is executing on the mobile station; and

communicating with the mobile station based upon the specified quality of service and the characteristics of the packet wireless communications network.

12. A method according to Claim 11 wherein the step of receiving comprises the step of:

receiving from the mobile station an indication of a quality of service based upon the voice, data processing or multimedia application that is executing on the mobile station and that is independent of performance characteristics of the packet wireless communication network.

13. A method according to Claim 11 wherein the specified quality of service comprises at least one of a delay sensitivity and an error rate.

14. A communication system comprising:

a packet wireless communications network;

a mobile station that executes voice, data processing or multimedia applications that generate respective voice, processed data or multimedia communications that are communicated to the packet wireless communications network by the mobile station as packetized data;

means for specifying a quality of service for the mobile station based upon the voice, data processing or multimedia application that is executing on the mobile station; and

means for conveying the specified quality of service from the mobile station to the packet switched wireless communication network.

15. A system according to Claim 14 further comprising:

means for establishing communications with the mobile station based upon the specified quality of service and the characteristics of the packet wireless communications network.

16. A system according to Claim 14 wherein the means for specifying a quality of service comprises:

means for specifying a quality of service for the mobile station based upon the voice, data processing or multimedia application that is executing on the mobile station and that is independent of performance characteristics of the packet wireless communication network.

17. A system according to Claim 14 wherein the specified quality of service comprises at least one of a delay sensitivity and an error rate.

18. A system according to Claim 14 wherein the means for specifying comprises:

means for accepting a quality of service specification at the mobile station from a user of the voice, data processing or multimedia application that is executing on the mobile station.

19. A mobile station that communicates with a packet wireless communications network, the mobile station comprising:

at least one voice, data processing or multimedia application that generates respective voice, processed data or multimedia communications;

an application programming interface that specifies a quality of service based upon the voice, data processing or multimedia application; and

a packet switched wireless transmitter that communicates the voice, processed data or multimedia communications to the packet wireless communications network as packetized data and that conveys the specified quality of service to the packet switched wireless communication network.

20. A mobile station according to Claim 19 further comprising:

a packet switched wireless receiver that receives communications from the packet wireless communications network based upon the specified quality of service and the characteristics of the packet wireless communications network.

21. A mobile station according to Claim 19 wherein the application programming interface specifies a quality of service based upon the voice, data processing or multimedia application and that is independent of performance characteristics of the packet wireless communication network.

22. A mobile station according to Claim 19 wherein the specified quality of service comprises at least one of a delay sensitivity and an error rate.

23. A mobile station according to Claim 19 wherein the application programming interface accepts a quality of service specification from a user of the voice, data processing or multimedia application.

24. A packet wireless communications network that communicates with a mobile station, the mobile station executing voice, data processing or multimedia applications that generate respective voice, processed data or multimedia communications, the packet wireless communications network comprising:

an interface that receives from the mobile station an indication of a quality of service based upon the voice, data processing or multimedia application that is executing on the mobile station; and

a packet switched wireless transceiver that communicates the voice, processed data or multimedia communications with the mobile station as packetized data, based upon the specified quality of service and the characteristics of the packet wireless communications network.

25. A network according to Claim 24 wherein the interface comprises:
an interface that receives from the mobile station an indication of a quality of service based upon the voice, data processing or multimedia application that is executing on the mobile station and that is independent of performance characteristics of the packet wireless communication network.

26. A network according to Claim 24 wherein the specified quality of service comprises at least one of a delay sensitivity and an error rate.

27. A communication method between a Mobile Station (MS) and an Enhanced General Packet Radio Service (EGPRS) Radio Access Network (RAN), the MS comprising Terminal Equipment (TE) that executes voice, data processing or multimedia applications that generate respective voice, processed data or multimedia communications, and a Mobile Terminal (MT) that communicates the voice, processed data or multimedia communications to the EGPRS RAN as packetized data, the method comprising the steps of:

specifying at the TE, a quality of service for the communications between the TE and the EGPRS RAN based upon the voice, data processing or multimedia application that is executing on the TE;

conveying the specified quality of service from the TE to the MT; and

communicating the specified quality of service from the MT to the EGPRS RAN.

28. A method according to Claim 27 further comprising the following step that is performed by the EGPRS RAN:

establishing communications with the MS based upon the specified quality of service and the characteristics of the EGPRS RAN.

29. A method according to Claim 27 wherein the step of specifying a quality of service comprises the step of:

specifying at the TE, a quality of service for the communications between the TE and the EGPRS RAN based upon the voice, data processing or multimedia application that is executing on the TE and that is independent of performance characteristics of the EGPRS RAN.

30. A method according to Claim 27 wherein the specified quality of service comprises at least one of a delay sensitivity and an error rate.

31. A method according to Claim 27 wherein the step of specifying comprises:

accepting a quality of service specification at the TE from a user of the voice, data processing or multimedia application that is executing on the TE.

32. A communication method for a Mobile Station (MS) that communicates with an Enhanced General Packet Radio Service (EGPRS) Radio Access Network (RAN), the MS comprising Terminal Equipment (TE) that executes voice, data processing or multimedia applications that generate respective voice, processed data or multimedia communications, and a Mobile Terminal (MT) that communicates the voice, processed data or multimedia communications to the EGPRS RAN as packetized data, the method comprising the steps of:

specifying at the TE, a quality of service for the communications between the TE and the EGPRS RAN based upon the voice, data processing or multimedia application that is executing on the TE;

conveying the specified quality of service from the TE to the MT; and

communicating the specified quality of service from the MT to the EGPRS RAN.

33. A method according to Claim 32 further comprising the step of:

receiving communications with from the EGPRS RAN based upon the specified quality of service and the characteristics of the EGPRS RAN.

34. A method according to Claim 32 wherein the step of specifying a quality of service comprises the step of:

specifying at the TE, a quality of service for the communications between the TE and the EGPRS RAN based upon the voice, data processing or multimedia application that is executing on the TE and that is independent of performance characteristics of the EGPRS RAN.

35. A method according to Claim 32 wherein the specified quality of service comprises at least one of a delay sensitivity and an error rate.

36. A method according to Claim 32 wherein the step of specifying comprises:

accepting a quality of service specification at the TE from a user of the voice, data processing or multimedia application that is executing on the TE.

37. A communication method for an Enhanced General Packet Radio Service (EGPRS) Radio Access Network (RAN) that communicates with a Mobile Station (MS), the MS executing voice, data processing or multimedia applications that generate respective voice, processed data or multimedia communications that are communicated to the packet wireless communications network by the mobile station as packetized data, the method comprising the steps of:

receiving from the MS an indication of a quality of service based upon the voice, data processing or multimedia application that is executing on the mobile station; and

communicating with the MS based upon the specified quality of service and the characteristics of the EGPRS RAN.

38. A method according to Claim 37 wherein the step of receiving comprises the step of:

receiving from the MS an indication of a quality of service based upon the voice, data processing or multimedia application that is executing on the mobile station and that is independent of performance characteristics of the EGPRS RAN.

39. A method according to Claim 37 wherein the specified quality of service comprises at least one of a delay sensitivity and an error rate.

40. A communication system comprising:

an Enhanced General Packet Radio Service (EGPRS) Radio Access Network (RAN);

a Mobile Station (MS) comprising Terminal Equipment (TE) that executes voice, data processing or multimedia applications that generate respective voice, processed data or multimedia communications, and a Mobile Terminal (MT) that communicates the voice, processed data or multimedia communications to the EGPRS RAN as packetized data;

means for specifying a quality of service for the communications between the TE and the EGPRS RAN based upon the voice, data processing or multimedia application that is executing on the TE;

means for conveying the specified quality of service from the TE to the MT; and

means for communicating the specified quality of service from the MT to the EGPRS RAN.

41. A system according to Claim 40 further comprising:

means for establishing communications with the MS based upon the specified quality of service and the characteristics of the EGPRS RAN.

42. A system according to Claim 40 wherein the means for specifying a quality of service comprises:

means for specifying a quality of service for the communications between the TE and the EGPRS RAN based upon the voice, data processing or multimedia application that is executing on the TE and that is independent of performance characteristics of the EGPRS RAN.

43. A system according to Claim 40 wherein the specified quality of service comprises at least one of a delay sensitivity and an error rate.

44. A system according to Claim 40 wherein the means for specifying comprises:

means for accepting a quality of service specification at the TE from a user of the voice, data processing or multimedia application that is executing on the TE.

45. A system according to Claim 40 wherein the means for specifying comprises:

a Quality of Service application that runs on a User Datagram Protocol (UDP) layer on the TE and that allows the voice, data processing or multimedia application that is executing on the TE to specify a quality of service.

46. A system according to Claim 45 wherein the means for conveying comprises:

a socket based R interface between the TE and MT that conveys the specified quality of service from the TE to the MT using a PPP link layer.

47. A system according to Claim 46 wherein the means for communicating comprises:

a Quality of Service application that runs on a User Datagram Protocol (UDP) layer on the MT to communicate the specified quality of service from the MT to the EGPRS RAN.

48. A Mobile Station (MS) that communicates with an Enhanced General Packet Radio Service (GPRS) Radio Access Network (RAN), the MS comprising:

Terminal Equipment (TE);

at least one voice, data processing or multimedia application that executes on the TE to generate respective voice, processed data or multimedia communications;

a Mobile Terminal (MT) that communicates the voice, processed data or multimedia communications to the EGPRS RAN as packetized data; and

an application programming interface between the TE and the MT that specifies a quality of service based upon the voice, data processing or multimedia application;

the MT conveying the specified quality of service to the EGPRS RAN.

49. An MS according to Claim 48 wherein the MT further receives communications from the EGPRS RAN based upon the specified quality of service and the characteristics of the EGPRS RAN.

50. An MS according to Claim 48 wherein the application programming interface between the TE and the MT specifies a quality of service based upon the voice, data processing or multimedia application and is independent of performance characteristics of the EGPRS RAN.

51. An MS according to Claim 48 wherein the specified quality of service comprises at least one of a delay sensitivity and an error rate.

52. An MS according to Claim 48 wherein the application programming interface accepts a quality of service specification from a user of the voice, data processing or multimedia application.

53. An MS according to Claim 48 wherein the application programming interface comprises:

a Quality of Service application that runs on a User Datagram Protocol (UDP) layer on the TE and that allows the voice, data processing or multimedia application that is executing on the TE to specify a quality of service.

54. An MS according to Claim 53 wherein the application programming interface further comprises:

a socket based R interface between the TE and MT that conveys the specified quality of service from the TE to the MT using a PPP link layer.

55. An MS according to Claim 54 wherein the MS comprises:

a Quality of Service application that runs on a User Datagram Protocol (UDP) layer on the MT to communicate the specified quality of service from the MT to the GPRS RAN.

56. An Enhanced General Packet Radio Service (EGPRS) Radio Access Network (RAN) that communicates with a Mobile Station (MS) that executes voice, data processing or multimedia applications that generate respective voice, processed data or multimedia communications, the EGPRS RAN comprising:

an interface that receives from the MS an indication of a quality of service based upon the voice, data processing or multimedia application that is executing on the MS; and

a Radio Network System that communicates the voice, processed data or multimedia communications with the MS as packetized data, based upon the specified quality of service and the characteristics of the EGPRS RAN.

57. An EGPRS RAN according to Claim 56 wherein the interface receives from the MS an indication of a quality of service based upon the voice, data processing or multimedia application that is executing on the MS and that is independent of performance characteristics of the EGPRS RAN.

58. An EGPRS RAN according to Claim 56 wherein the specified quality of service comprises at least one of a delay sensitivity and an error rate.

59. An EGPRS RAN according to Claim 56 wherein the interface comprises:

a Quality of Service application that runs on a User Datagram Protocol (UDP) layer on the BSS to receive from the MS the indication of a quality of service based upon the voice, data processing or multimedia application that is executing on the MS.

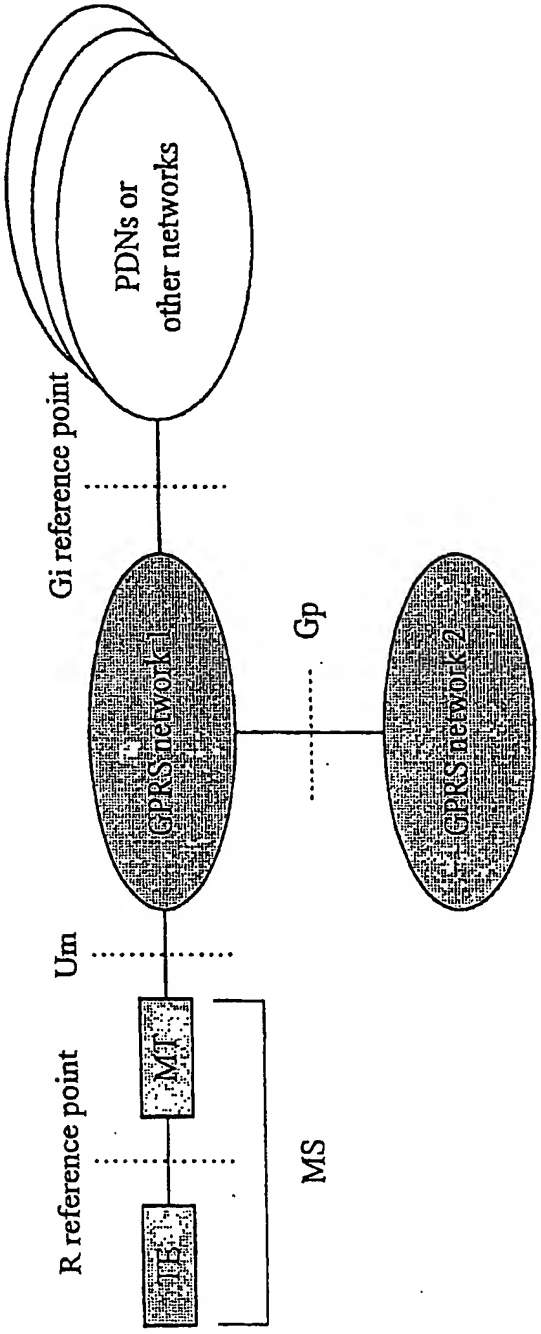

PDNs or other networks
Gi reference point
GPRS network 1
Gp
GPRS network 2
Um
MT
R reference point
TE
MS

FIG. 1

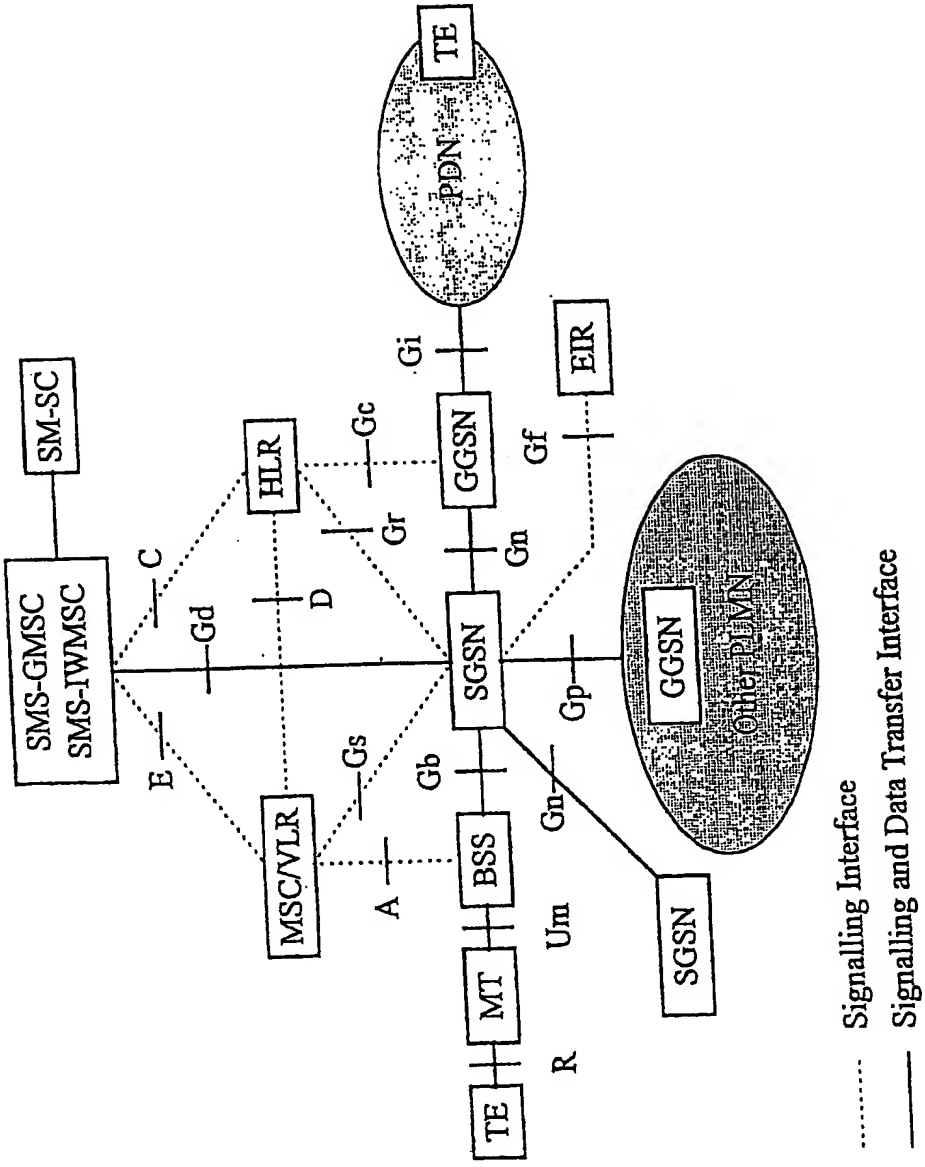

SM-SC
SMS-GMSC
SMS-IWMSC
C
Gd
D
HLR
Gc
Gr
E
Gs
MSC/VLR
A
Gb
BSS
SGSN
Gn
Gp
Um
MT
R
TE
TE
PDN
Gi
GGSN
Gn
Gf
EIR
GGSN
Other PLMN
SGSN
Signalling Interface
Signalling and Data Transfer Interface

FIG 2

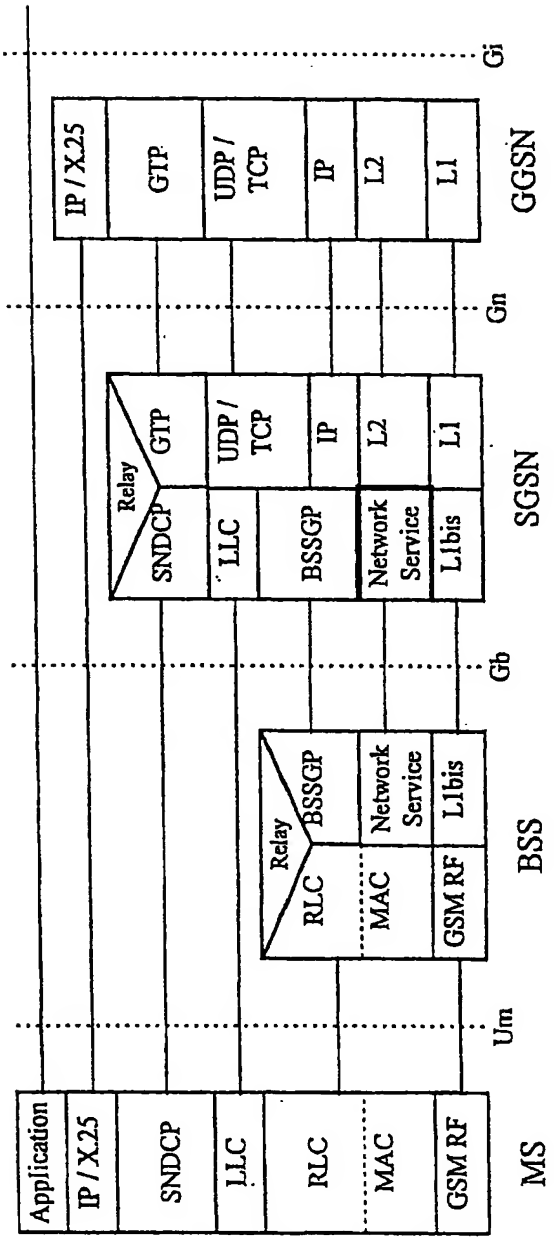

Gi
IP / X.25
GTP
UDP / TCP
IP
L2
L1
GGSN
Gn
Relay
GTP
SNDCP
UDP / TCP
LLC
IP
BSSGP
L2
Network Service
L1
L1bis
SGSN
Gb
Relay
BSSGP
RLC
Network Service
MAC
L1bis
GSM RF
BSS
Um
Application
IP / X.25
SNDCP
LLC
RLC
MAC
GSM RF
MS

FIG. 3

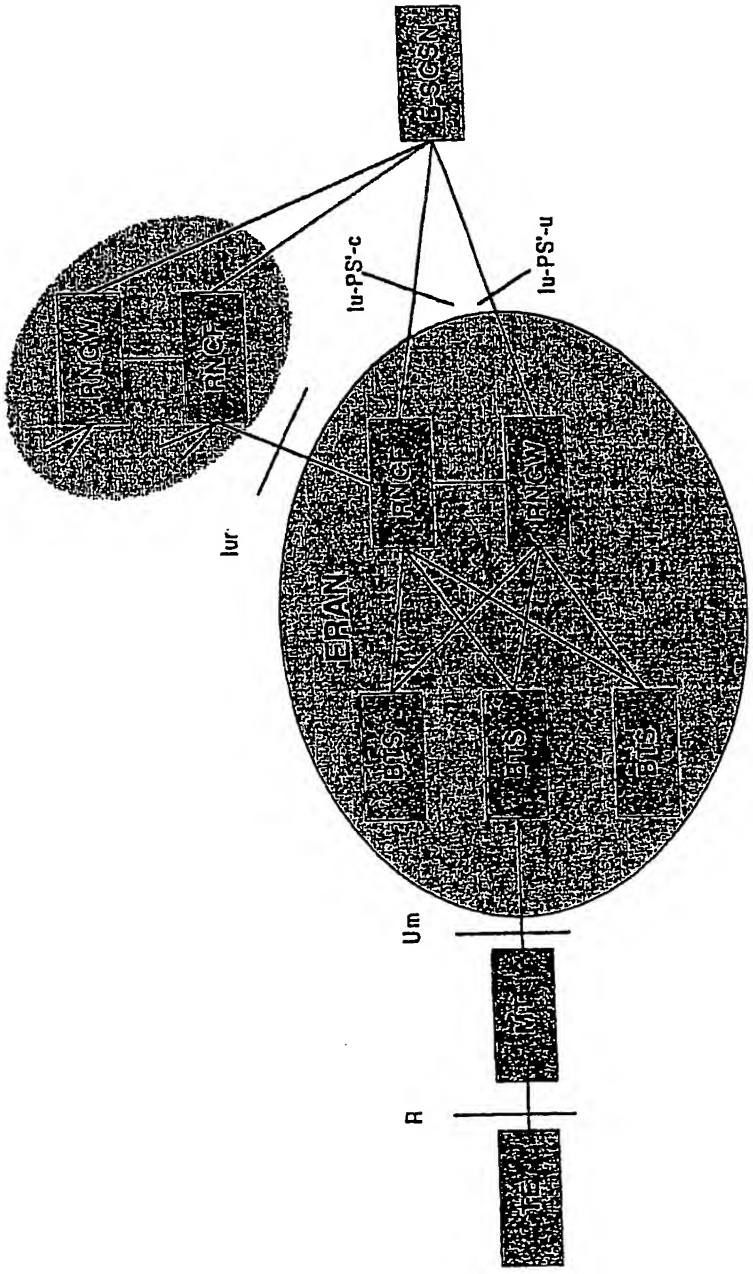

3G SGSN
Iu-PS'-c
Iu-PS'-u
RNGW
RNC
Iur
EBRAN
RNCF
RNGW
BTS
BTS
BTS
Um
R

FIG. 4

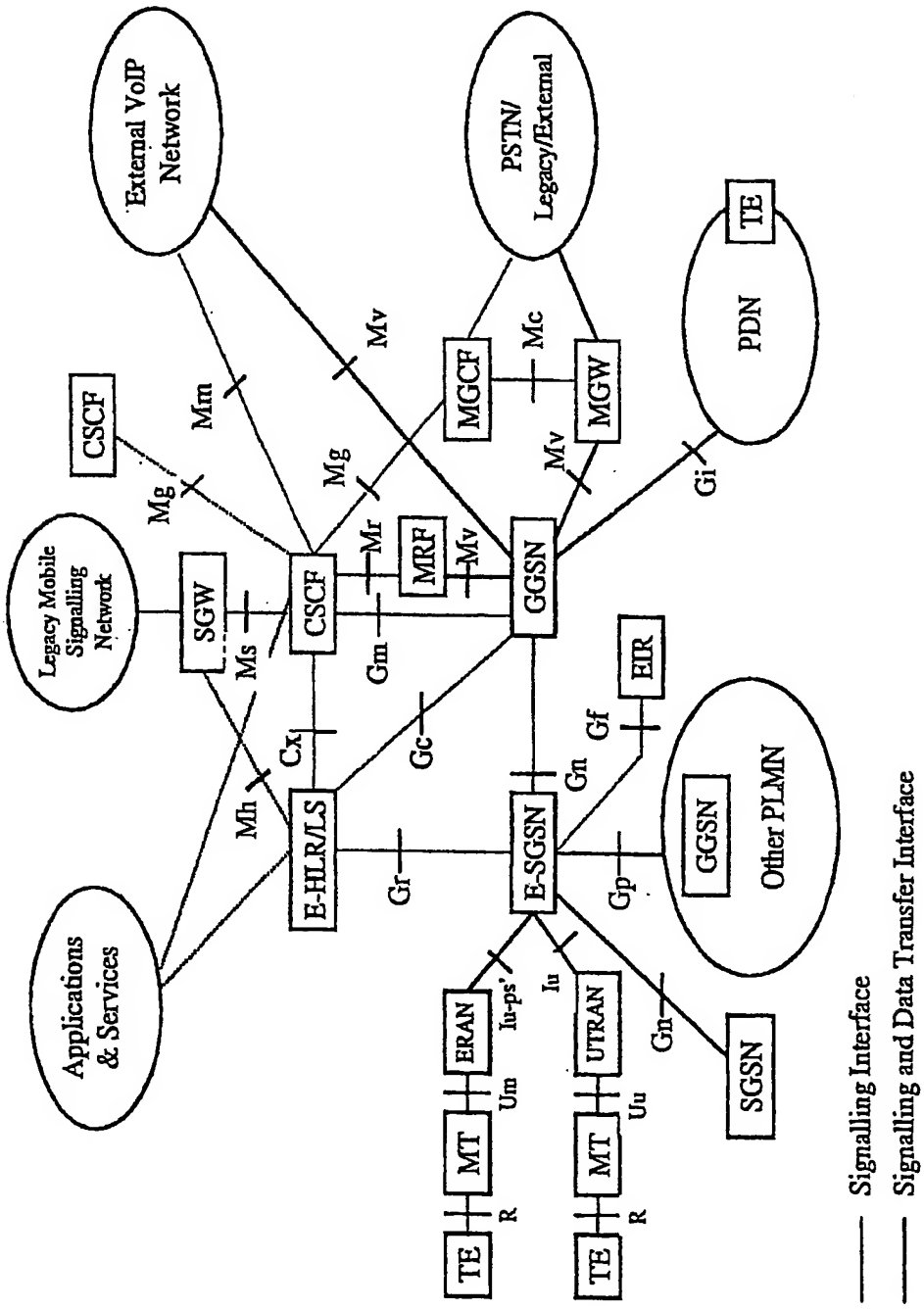
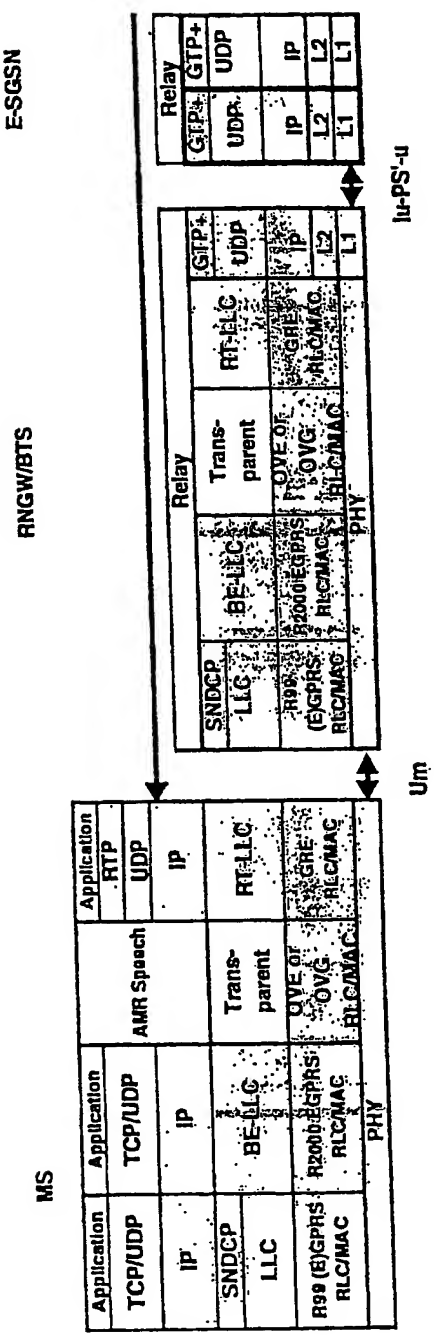

External VoIP Network
PSTN/ Legacy/External
PDN
TE
CSCF
Mm
Mv
Mg
MGCF
Mc
MGW
Mv
Gi
Legacy Mobile Signalling Network
SGW
Ms
CSCF
Mr
MRF
Mv
GGSN
Gm
HLR
Gf
Cx
Gc
Gn
Mh
E-HLR/LS
Gr
E-SGSN
Gp
GGSN
Other PLMN
Applications & Services
ERAN
Iu-ps'
Iu
UTRAN
Gn
SGSN
Um
Uu
MT
MT
R
R
TE
TE
Signalling Interface
Signalling and Data Transfer Interface

FIG. 5


MS
RNGW/BTS
E-SGSN
Application
TCP/UDP
IP
SNDCP
LLC
R99 (E)GPRS RLC/MAC
PHY
AMR Speech
RTP
UDP
IP
Trans-parent
RT-LLC
OVE or OVG
GRE
RLC/MAC
PHY
Relay
SNDCP
LLC
BE-LLC
R99 (E)GPRS RLC/MAC
PHY
Trans-parent
RT-LLC
OVE or OVG
GRE
RLC/MAC
PHY
GTP+
UDP
IP
L2
L1
Relay
GTP+
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GTP+
UDP
IP
L2
L1
Um
Iu-PS-u

FIG. 6

FIG. 7

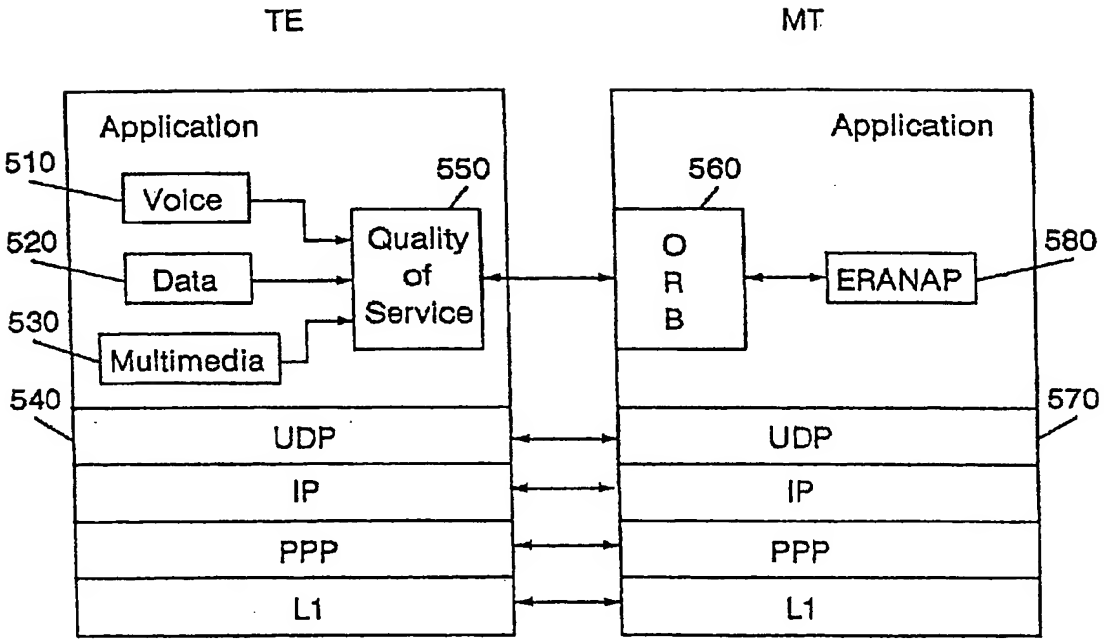
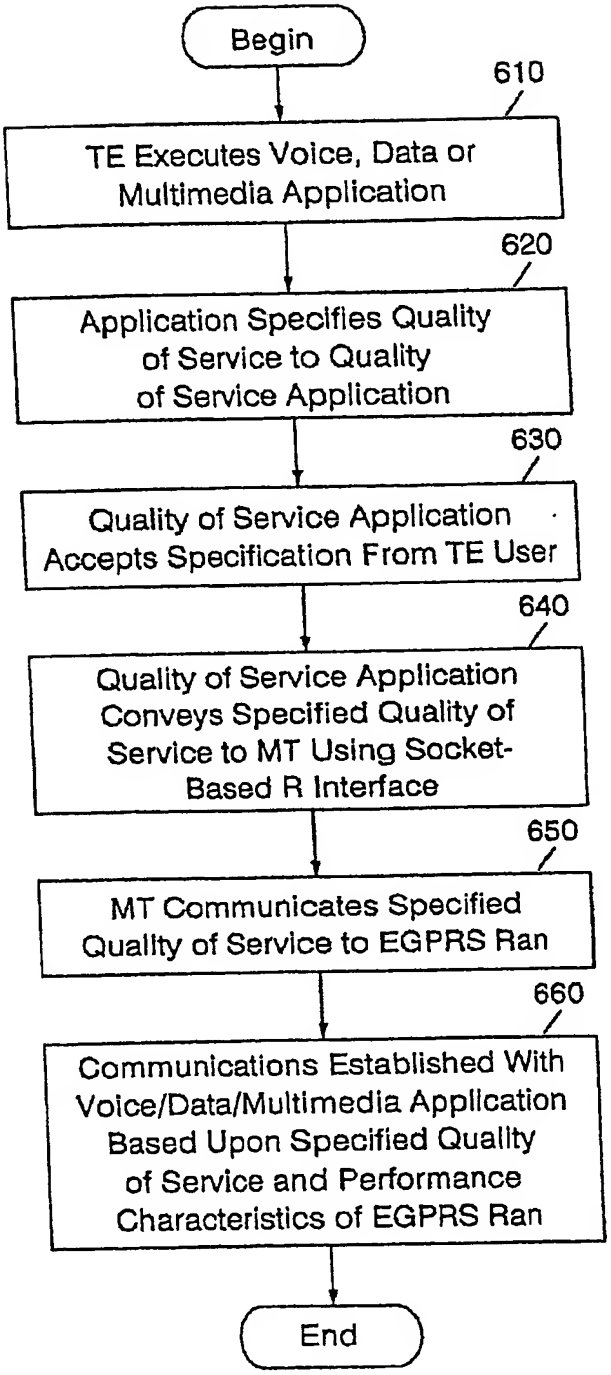

TE
MT
Application
Application
510
Voice
520
Data
530
Multimedia
550
Quality of Service
560
O R B
ERANAP
580
540
570
UDP
IP
PPP
L1
UDP
IP
PPP
L1

FIG. 8


Begin
610
TE Executes Voice, Data or Multimedia Application
620
Application Specifies Quality of Service to Quality of Service Application
630
Quality of Service Application Accepts Specification From TE User
640
Quality of Service Application Conveys Specified Quality of Service to MT Using Socket-Based R Interface
650
MT Communicates Specified Quality of Service to EGPRS Ran
660
Communications Established With Voice/Data/Multimedia Application Based Upon Specified Quality of Service and Performance Characteristics of EGPRS Ran
End

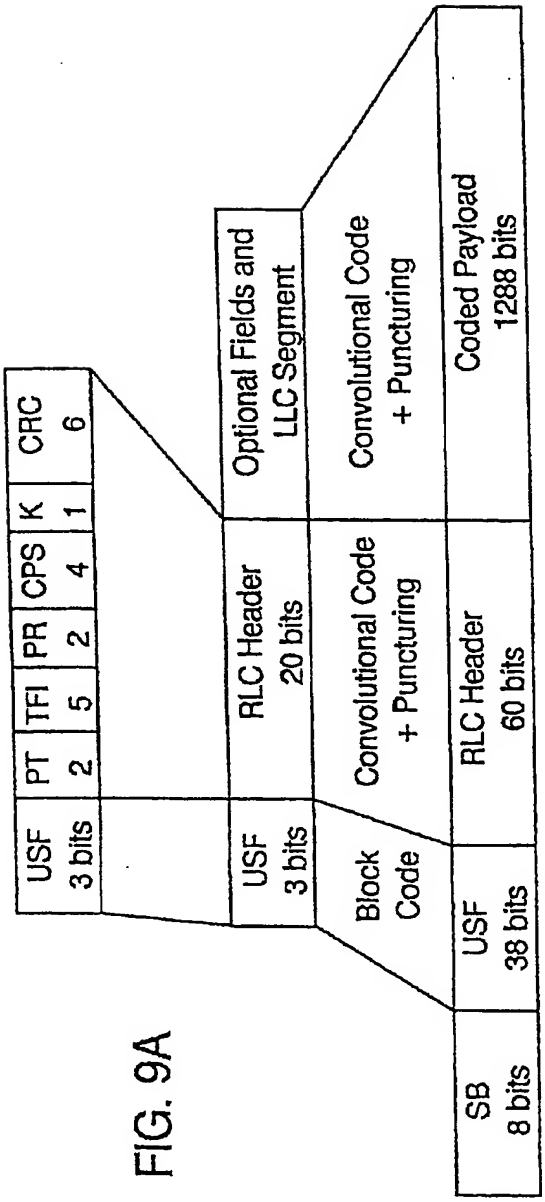

USF 3 bits
PT 2
TFI 5
PR 2
CPS 4
K 1
CRC 6
USF 3 bits
RLC Header 20 bits
Optional Fields and LLC Segment
Block Code
Convolutional Code + Puncturing
Convolutional Code + Puncturing
SB 8 bits
USF 38 bits
RLC Header 60 bits
Coded Payload 1288 bits

FIG. 9A

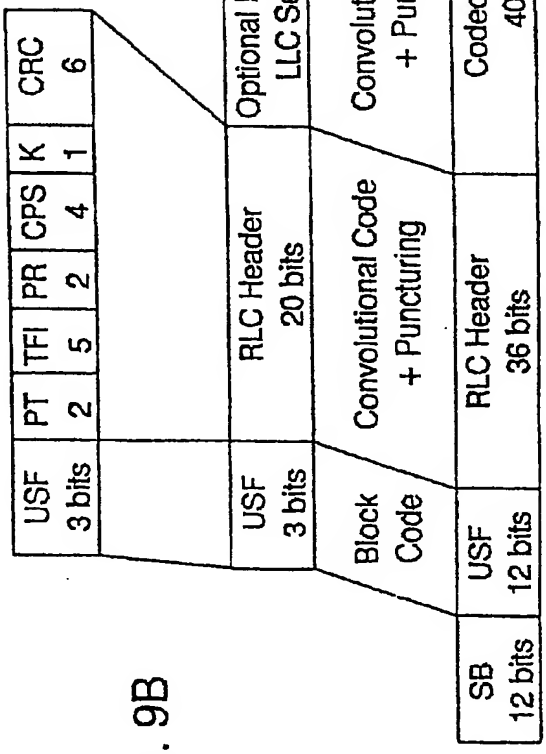

USF 3 bits
PT 2
TFI 5
PR 2
CPS 4
K 1
CRC 6
USF 3 bits
RLC Header 20 bits
Optional Fields and LLC Segment
Block Code
Convolutional Code + Puncturing
Convolutional Code + Puncturing
SB 12 bits
USF 12 bits
RLC Header 36 bits
Coded Payload 404 bits

FIG. 9B

FIG. 10

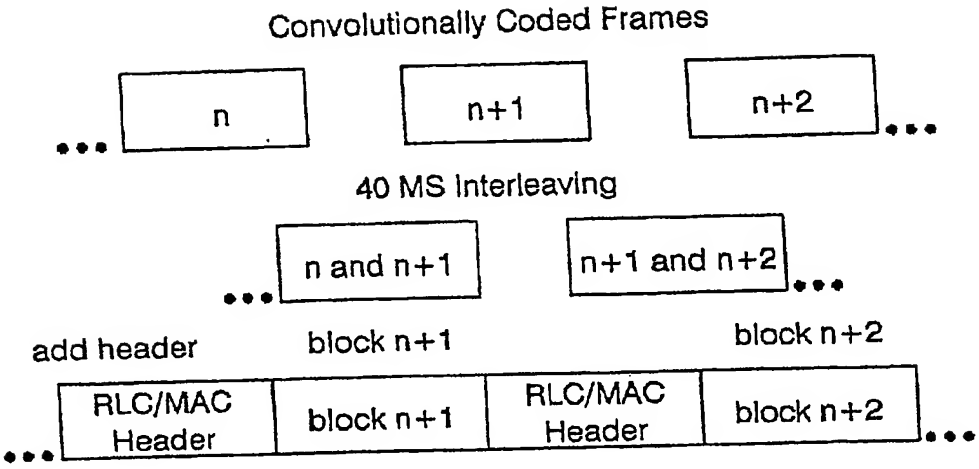


FIG. 11A

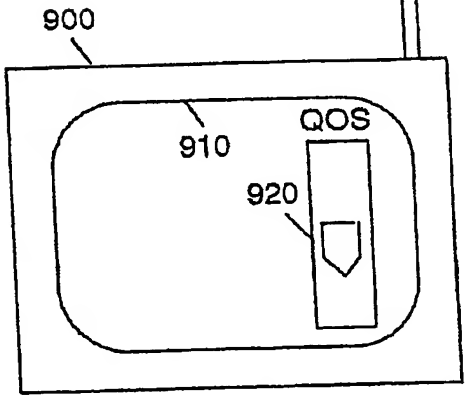
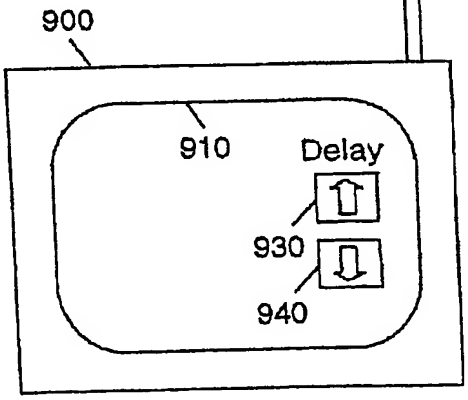


FIG. 11B



INTERNATIONAL SEARCH REPORT

Intern nal Application No
PCT/US 00/22261

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04Q7/38

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	WO 99 48310 A (NOKIA TELECOMMUNICATIONS OY.) 23 September 1999 (1999-09-23) abstract page 19, line 28 -page 20, line 30 ---	1,6,11, 14,19, 24,27, 32,37, 40,48,56
P,X	WO 00 10357 A (NOKIA NETWORKS OY.) 24 February 2000 (2000-02-24) figures 1,2 page 10, line 8 -page 11, line 7 --- -/--	1,6,11, 14,19, 24,27, 32,37, 40,48,56

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
29 November 2000	06/12/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Danielidis, S

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Intern nal Application No
PCT/US 00/22261

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
X	WO 99 16266 A (TELEFONAKTIEBOLAGET LM ERICSSON) 1 April 1999 (1999-04-01) figures 1-4 page 16, line 24 -page 17, line 18; claim 2 ---	1
A	WO 97 50263 A (TELIA AB) 31 December 1997 (1997-12-31) abstract; figure 1 page 11, line 10 -page 12, line 32 ---	19-23, 48-52
A	WO 98 32265 A (NOKIA TELECOMMUNICATIONS OY) 23 July 1998 (1998-07-23) page 8, line 1 - line 16 -----	19

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

...ormation on patent family members

Intern ...al Application No
PCT/US 00/22261

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9948310 A	23-09-1999	FI 980617 A	20-09-1999
		AU 2838999 A	11-10-1999
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